

What is claimed is:

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1 A method of producing on-demand, semi-solid material for a casting process, said method comprising the following steps:

heating a metal alloy until it reaches a molten state;  
transferring an amount of said molten alloy to a vessel;  
cooling said amount of molten alloy in said vessel;  
applying an electromagnetic field to said amount of molten alloy for creating a flow pattern of said molten alloy within said vessel while said cooling continues in order to create a slurry billet; and  
discharging said slurry billet from said vessel into a shot sleeve of a casting machine.

2. The method of claim 1 wherein the performance of the transferring, cooling, applying, and discharging steps has a total cycle time of between 4 seconds and 250 seconds.

3. The method of claim 2 wherein said transferring step is performed in between approximately 2 seconds and 35 seconds.

4. The method of claim 3 wherein said cooling and said applying steps are performed in a combined time of between approximately 2 seconds and 120 seconds.

5. The method of claim 4 wherein said discharging step is performed in between approximately 0.1 second and 30 seconds.

6. The method of claim 1 wherein said transferring step is performed in between approximately 2 seconds and 35 seconds.

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7. The method of claim 1 wherein said cooling and said applying steps are performed in a combined time of between approximately 2 seconds and 150 seconds.

8. The method of claim 1 wherein said discharging step is performed in between approximately 0.1 seconds and 30 seconds.

9. The method of claim 1 wherein said transferring step includes the use of a robotic arm and a cooperating ladle.

10. The method of claim 9 wherein said applying step is performed by moving said vessel into a stator before said transferring step is performed.

11. The method of claim 10 wherein said cooling step is performed by providing a flow of cooling air between said vessel and said stator.

12. The method of claim 10 which further includes the step of clamping a thermal jacket around said vessel, said thermal jacket being positioned within said stator and said clamping step occurring before said transferring step.

13. The method of claim 1 wherein said applying step is performed by moving said vessel into a stator before said transferring step is performed.

14. The method of claim 1 wherein said cooling step is performed by providing a flow of cooling air between said vessel and said stator.

15. The method of claim 1 which further includes the step of clamping a thermal jacket around said vessel, said thermal jacket being positioned within said stator and said clamping step occurring before said transferring step.

16. The method of claim 1 wherein said transferring step includes the use of an automatic mechanical ladle.

17. The method of claim 1 wherein said stator is a multi-phase, multiple pole stator using circumferential flow in the molten metal.

18. The method of claim 1 wherein said stator is a multi-phase, multiple pole stator causing longitudinal flow in the molten metal.

19. The method of claim 1 which further includes the step of adding particulate solid particles into the metal alloy for forming a metal matrix composite.

20. An apparatus for producing on-demand, semi-solid material for a casting process, said apparatus comprising:

a vessel constructed and arranged for receipt of an amount of molten alloy; means for moving said vessel between a forming station and a discharge location;

a stator constructed and arranged for effecting electromagnetic stirring of the amount of molten alloy, said vessel being positioned within said stator; and

cooling means for lowering the temperature of said amount of molten alloy while said electromagnetic stirring is performed so as to produce a slurry billet within a comparatively short cycle time which is less than three minutes.

21. The apparatus of claim 20 wherein said cooling means includes a thermal jacket positioned between said stator and said vessel.

22. The apparatus of claim 21 wherein said thermal jacket has a split-half design and is constructed and arranged so as to be openable prior to receiving said vessel and to be closeable so as to clamp around said vessel.

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*Substantially*

23. The apparatus of claim 20 which further includes discharge means for removing the slurry billet from the vessel and loading it into a shot sleeve of a casting machine.

24. A method of producing shaped metal parts from on-demand, semi-solid metal with degenerate dendritic primary solid particles, said method comprising the following steps:

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heating a metal until it reaches a molten state;  
transferring an amount of said molten metal to a vessel, while controllably cooling said amount of molten metal in said vessel;  
applying an electromagnetic field to said amount of molten metal for creating a flow pattern of said molten metal within said vessel until a desired molding temperature within the semi-solid range is reached, thereby creating a slurry; and  
discharging said slurry from said vessel into a shot sleeve of a casting machine.

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25. The method of claim 24 which further includes the step of operating said casting machine in order to cast the slurry into the form of a shaped metal part.

26. The method of claim 25 wherein the performance of the transferring, cooling, applying and discharging steps has a total cycle time of between 4 seconds and 250 seconds.

27. An apparatus for producing shaped metal parts from on-demand, semi-solid metal with degenerate dendritic primary solid particles, said apparatus comprising:

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etc.

a vessel constructed and arranged for receipt of an amount of molten alloy;  
means for moving said vessel between a forming station and a discharge location;

a stator constructed and arranged to generate sufficient electromagnetic forces for stirring the amount of molten alloy, said vessel being positioned within said stator; and

cooling means for lowering the temperature of said amount of molten alloy while said electromagnetic stirring is performed so as to produce a slurry billet within a comparatively short cycle time which is less than 4 minutes.

28. The apparatus of claim 27 which further includes discharge means for transferring said slurry billet from the vessel into a shot sleeve of a forming press.

29. The apparatus of claim 28 wherein said cooling means includes a thermal jacket positioned between said stator and said vessel.

30. An apparatus for producing shaped metal parts, on-demand, from a metal alloy having particulate solid particles as a metal matrix composite, said apparatus comprising:

a vessel constructed and arranged for receipt of an amount of said metal matrix composite;

means for moving said vessel between a forming station and a discharge

and scuff location;

a stator constructed and arranged to generate sufficient electromagnetic forces for stirring the amount of molten alloy, said vessel being positioned within said stator; and

cooling means for lowering the temperature of said amount of molten alloy while said electromagnetic stirring is performed so as to produce a slurry billet within a comparatively short cycle time which is less than 4 minutes.

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